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# PROTOMARATTIA, A NEW GENUS OF MARATTIACEAE, AND ARCHANGIOPTERIS

(WITH PLATE I AND THREE FIGURES)

BUNZO HAYATA

The Marattiaceae constitute a small family which may be regarded as the survivor of a much larger group. At present only 6 genera are known: *Archangiopteris*,<sup>1</sup> *Macroglossum*,<sup>2</sup> *Angiopteris*, *Marattia*, *Christensenia* (*Kaulfussia*), and *Danaea*. *Archangiopteris* was first discovered by A. HENRY in Yunnan and was published in 1899 by CHRIST and GIESENHAGEN as a genus connecting *Angiopteris* with *Danaea*. The type of the genus *A. Henryi* is shown to be one of the most primitive forms of Marattiaceae by its simply pinnate leaves and simple stelar structure.<sup>3</sup> According to GWYNNE-VAUGHAN,<sup>4</sup> the mature stem of *Archangiopteris* retains a stage which is rapidly passed through by the young plants of *Angiopteris* and other genera. The same seems to hold true as to the form of the leaves. As far as I have observed *Angiopteris* in its habitat in Formosa, the first 2 or 3 leaves from a young stock usually are simply pinnate, but die before they reach maturity and become fertile. The pinnae of these first leaves are much larger than of those that follow, and closely resemble those of *Archangiopteris* in shape and size. We may infer, therefore, that *Archangiopteris* represents the form of a primitive type to which the ancestor of *Angiopteris* may have belonged.

*Archangiopteris* is most closely related to *Macroglossum*,<sup>5</sup> recently established by COPELAND, both in the simply pinnate fronds and

<sup>1</sup> CHRIST, H., and GIESENHAGEN, K., Pteridographische Notizen. Flora **86**:72-85. 1899.

<sup>2</sup> COPELAND, E. B., The ferns of the Malay-Asiatic region. Philipp. Jour. Sci. **4**:1-64. 1909.

<sup>3</sup> LOTSY, J. P., Vorträge über botanische Stammesgeschichte **2**:676. 1906.

<sup>4</sup> GWYNNE-VAUGHAN, D. T., On the anatomy of *Archangiopteris Henryi* and other Marattiaceae. Ann. Botany **19**:268. 1905.

<sup>5</sup> CAMPBELL, D. H., The genus *Macroglossum* Copeland. Philipp. Jour. Sci. **9**:199-223. 1914; The structure and affinities of *Macroglossum Alidae* Copeland. Ann. Botany **28**:651-669. 1914.

in the elongated linear sori, but differs from it in the absence of ridges between the sori and in the dorsiventral rhizomes. GWYNNE-VAUGHAN (*loc. cit.*) says that in the specimens examined by him there was no suggestion of dorsiventrality in the rhizome of *Archangiopteris*, and the leaf arrangement and the vascular structure indicated a radial symmetry. So far as I can judge from the figure given by the author,<sup>6</sup> however, there are some indications of dorsiventrality in the rhizome, as can be seen in the upward bending of the stipes of the leaves and in the fact that the rhizome ascends somewhat obliquely toward the apex; and it also may be inferred that the remaining portions of the rhizome not given in the figure very probably run horizontally. In *Archangiopteris Somai*, recently discovered in Formosa, and two other new species from Tonkin, which will be described later, the rhizomes are prostrate and show very clear signs of dorsiventrality.

In the summer of 1916 I was sent to Tonkin for collecting. I found there two new species of *Archangiopteris* and a type of a new genus closely related to the latter. All these plants present an appearance very similar to other ferns, such as *Coniogramme japonica*, *C. fraxinea*, *Diplaziopsis javanica*, or *Diplazium bantamense*, and occur in very small numbers amidst a multitude of the previously mentioned ferns. As it is very rarely that one has the opportunity to meet with these plants of *Archangiopteris* and the allied new genus, it may not be entirely out of place if I should tell how I was led to discover these very rare and interesting ferns.

Some 10 years ago I was greatly interested in learning of HENRY's discovery of *Archangiopteris*, representing as it did an ancient type of the Marattiaceae, and I wondered whether there might not exist another species of the genus in Formosa, the flora of which I have since then been studying. In 1915, when examining collections sent by the late T. SOMA from Formosa, I found among them a curious looking fern labeled *Gymnogramme japonica*. A glance at the specimen showed me that it was another type of *Archangiopteris*, which was then named and published as *A. Somai*.<sup>7</sup>

<sup>6</sup> GWYNNE-VAUGHAN, D. T., *loc. cit.* pl. 10. figs. 1 and 2.

<sup>7</sup> HAYATA, B., *Icones Plantarum Formosanarum*. 5:256; 6:154. pl. 19.

The next year I went to Formosa to the native place of the plant on the bank of a rivulet in a dense forest at an altitude of about 2000 ft. in the northern part of the island, for I wished to see a living specimen of this highly interesting fern. On the first day of our search we were not successful. The difficulty of finding it is partly due to its extreme rarity and partly to its existence only among other ferns closely resembling it in external appearance. On the second day I was at last successful in finding a few specimens of *Archangiopteris Somai*.

In the summer of 1917 I went to Chapa in the mountainous regions on the boundary between Yunnan and Tonkin. There too I wondered if I might not have the opportunity of finding some *Archangiopteris*, and so I made a careful search, turning back the leaves of all similar ferns which I came across. At last, as I had expected, I found a stock of the desired genus, in the shade of the forest at an altitude of about 4000 ft., between Chapa and Mueng-Xen. It was just a single stock. The fern resembled *A. Henryi*, but differed from it in the absence of indusium scales in the middle of the sori. It was a new species which I propose to call *A. sub-integra*, a description of it being given in the present paper. Later on I went to Mt. Tamdao in the central part of Tonkin, and collected in a forest at an altitude of about 3000 ft. There I saw on the side of the forestry service path one poor specimen which I thought most certainly a species of *Archangiopteris* before examining the fern. It was a sterile specimen, yet I believed it to be a plant of the same genus, until I found near by some fertile specimens. They revealed the fact that they were different from *Archangiopteris* in fructification, all other characters being exactly like the latter. The sporangia of the newly discovered plant were quite fused together, reminding one exactly of those of *Marattia*, but differing from the latter in the long linear synangium. I thought that it might be a type of a new genus intermediate between *Archangiopteris* and *Marattia*; but I shall refer to this later. Not very far from there I collected a true *Archangiopteris*, another new species, which I propose to call *A. tamdaoensis*. *Archangiopteris*, therefore, formerly a monotypic genus, has come to comprise 4 species. As to distribution, the species are extremely local.

*A. Henryi* is only known from Mentzu (Yunnan); *A. Somai* exists in one or two spots in the northern part of Formosa; *A. subintegra* occurs in one place in the mountains of Chapa between Yunnan and Tonkin; and *A. tamdaoensis* is found in one locality on Mt. Tamdao (Tonkin); and the new genus is also limited to one spot on Mt. Tamdao.

Returning to the systematic position of the new genus, the most remarkable feature which separates the new type from all the other genera of the Marattiaceae is its elongated linear or even vermiform synangium. The other important characters are its horizontal dorsiventral rhizomes and simply pinnate fronds. Through the dorsiventral rhizomes it is related to *Kaulfussia* and *Archangiopteris*; by the simple pinnate fronds it is allied to *Macroglossum*, *Danaea*, and *Archangiopteris*; in the structure of the synangium its nearest of kin is to be found in *Marattia*. It is distinguishable from the latter, however, by its elongated linear synangium, simply pinnate fronds, and dorsiventral horizontal rhizome. It differs from *Archangiopteris* in having a synangium; from *Macroglossum* in the dorsiventral rhizomes and synangium; from *Angiopteris* in the simple pinnate leaves, dorsiventral rhizomes, and synangium; from *Danaea* in the synangium with a longitudinal common slit; and from *Kaulfussia* in the pinnate leaves and linear synangium. After considering all these cases, I am forced to the conclusion that the new plant must be a type representing a new genus. I propose to call it *Protomarattia*, as it bears exactly the same relation to *Marattia* as *Archangiopteris* does to *Angiopteris*.

As was stated, *Protomarattia* closely resembles *Marattia* in the reproductive organs, while it is closely related to *Archangiopteris* in its vegetative organs. The similarity of the type of the new genus and *Archangiopteris tamdaoensis* in the fronds and rhizomes, even in the serration and venation, is really so very great that I entirely failed to distinguish the one from the other until I saw the sori. The protective arrangement of stipules and commissures of our plant is exactly like that in *Archangiopteris*. The synangium also, presenting a linear form, with comparatively thinner lateral walls and a little looser connection of locules, more or less tends toward the sorus of *Archangiopteris*, or even toward that of

*Macroglossum*.<sup>8</sup> There can be no doubt, therefore, that the genus is closely related to *Marattia* on the one hand, while on the other it is nearly allied to *Archangiopteris*. It represents presumably a form of an ancient and conserved type connecting *Marattia* with *Archangiopteris*.

**Protomarattia**, nov. gen.—Rhizoma dorsiventrale oblique vel horizontaliter prostratum, reliquiis stipitum dense obtectum, radicibus e latere ventrali oriundis. Folia circum rhizoma spirali-ter disposita; stipulis e latere adaxiali stipitis commissura connexis; stipitibus rectis duobus locis basi et superiore geniculato-incrassatis post finitas functiones e geniculo superiore et iterum basilari solutis; frondibus simpliciter pari- vel impari-pinnatis, pinnis patentibus vel interdum retrorsum reflexis; petiolulis pinnarum incrassatis. Synangium lineare submarginale e margine pinnae 4–6 mm. distans subsessile rima mediana longitudinali apertum; indusio e squamis numerosissimis laceratis inprimis constituto, demum evanescenti.

Differt a *Marattia* synangio lineari nec ovali, loculis multo numerosioribus, fronde multo minore simpliciter nec pluries pinnata et rhizomate dorsiventrali repente nec erecto; differt a *Archangiopteris* synangio.

In Tonkin incola ad huc monotypica.

**Protomarattia tonkinensis**, sp. nov.—Rhizoma incrassatum horizontaliter vel oblique repens dorsiventrale, in specimine exsic-cato nostro 15 cm. longum cum reliquiis foliorum 2.5 cm. latum, reliquiis stipitum et stipulis dense obtectum e latere ventrali radices incrassatas teretes emittens. Folia versus apicem rhizomatis 5–6 approximativim disposita. Stipites 30–40 cm. longi erecti plano-convexi in sectione duobus locis ad basin et ad 0.3 altitudinem a basi geniculato-incrassati, basi dense sursum pauce squamulati, squamulis lanceolatis vel linearibus circ. 2 mm. longis margine erosis; partibus incrassatis basilaribus geniculiformibus 2.5 cm. longis, 1.5 cm. latis utroque latere stipula et latere adaxiali com-missura instructis, stipulis coriaceis tenuiter 2-lobatis, lobis abaxi-alibus (anterioribus) minoribus late semirotundatis, 1 cm. latis, 7 mm. longis margine erosis et membranaceis folium proprium (in

<sup>8</sup> CAMPBELL, D. H., The structure and affinities of *Macroglossum Alidae* Cope-land. Ann. Botany 28:664. 1914.

alabastro) obtegentibus, lobis adaxialibus (posterioribus) majoribus semi-obovatis 1.5 cm. longis 7 mm. latis margine erosis et tenuibus cum commissura alabastrum folii juxta venientis obtegentibus; partibus incrassatis superioribus geniculiformibus, 2 cm. longis, 7–10 mm. in diametro sectionis in vivo nitidis; foliis post finitas functiones ex apice partis incrassatae basilaris et e parte incrassata superiore texturae degenerationi solutis. Frondes simpliciter pari- vel impari-pinnatae in ambitu obovatae vel ovatae stipitem in longitudine fere aequantes, circ. 30 cm. longae, 20–25 cm. latae, pinnis 4–5, rarius 3–7, alternis inferioribus minoribus superioribus majoribus, patentissimis vel interdum retrorsum reflexis, pinnis superioribus lanceolatis plus minus falcatis, 25–28 cm. longis, 5–6 cm. latis apice ad caudam abrupte acuminatis (cauda apicali lineari, 2–3 cm. longa, medio 4 mm. lata, serrata), basi subito triangulari-cuneatis (parte cuneata 1.5 cm. longa latere recta integra), margine planis nec recurvis nec undulatis minute serrulatis (serrula triangulari-acuta ascendenti), supra atroviridibus nitidis subtus pallidissimis subglabris ad costam et venas paucissime squamulatis (squamula minutissima), costa utraque facie elevata 1–2 mm. lata in exsiccatu nigricanti; venis parallelis a costa angulo 80° egressis simplicibus vel e basi furcatis fere rectis prope marginem subite recurvo-ascendentibus a se 1.5 mm. distantibus ad apicem serrularum attingentibus apice haud incrassatis in exsiccatu nigricantibus; petiolulis pinnarum circ. 1 cm. longis incrassatis squamulatis; rhachis frondis supra medio tenuiter sulcata in vivo angustissime alata 4–7 cm. longa; textura chartacea vel chartaceo-membranacea. Synangia numerosissima subsessilia secus venas vel venulas utroque latere costae prope marginem 1-seriatim approximativque disposita, e margine 3–5 mm. ditantia, linearia vel vermiformia 4–6 mm. longa, 1 mm. lata rima longitudinali mediana aperta, primum squamulis laceratis indusiorum oblecta demum nuda, loculis numerosissimis utroque latere receptaculi 20–60 dispositis.

HABITAT.—Monte Tamdao (Tonkin), in silva ad 3000 ped. alt., leg. *B. Hayata*, July 1917.

ARCHANGIOPTERIS Christ et Giesenhagen, Pteridographische Notizen, Flora 86:72. 1899; BITTER, Natürliche Pflanzenfam.

14:439; CHRISTENSEN, Ind. Filic. 62; CAMPBELL, Eusporangiateae, Publication no. 140, Carnegie Institution of Washington 203; LOTSY, Vorträg Bot. Stammesgeschichte 2:675.

#### KEY TO SPECIES

Indusium scales present between two rows of sporangia in a sorus. . . . *A. Henryi*  
 Indusium scales absent between two rows of sporangia in a sorus.

Pinnæ nearly entire, scales brown. . . . . *A. subintegra*

Pinnæ serrulate.

Scales dark brown or blackish. . . . . *A. tamdaoensis*

Scales brown. . . . . *A. Somai*

ARCHANGIOPTERIS HENRYI Christ et Giesenhagen, Pteridographische Notizen, Flora 86:77. 1899; GWYNNE-VAUGHAN, On the anatomy of *Archangiopteris Henryi*, etc., Ann. Botany 19:257-271. 1905.

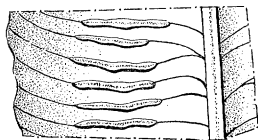


FIG. 1.—*Archangiopteris subintegra* Hayata.

HABITAT.—Mengtzu (Yunnan) ex HENRY.

**Archangiopteris subintegra** Hayata, sp. nov. (fig. 1).—Rhizoma horizontaliter vel plus minus oblique repens, in specimine nostro exsiccato 9 cm. longum cum reliquiis stipitum 4 cm. latum dorsiventrale reliquiis stipitum et stipulis persistentibus dense obtectum, radicibus incrassatis e latere ventrali rhizomatis oriundis. Stipes 70 cm. longus erectus basi dense sursum paucè squamulatus, squamulis lanceolatis, duobus locis basi et medio incrassatus, parte basilari incrassata 1 cm. longa totiusque lata stipulata, commissuris ut videntur obsoletis. Frons simpliciter pari- vel impari-pinnata in ambitu obovata, pinnis 5-7, superioribus majoribus lanceolatis, circ. 25 cm. longis, 5 cm. latis apice acuminatis ad caudas lineares abeuntibus (cauda 2-3 cm. longa serrulata), basi acutis margine cauda serrulata excepta fere integris; costa utraque pagine elevata, venis simplicibus vel a basi furcatis, venis et venulis parallelis a se 2.5 mm. distantibus patentissimis a costa angulo 85° egressis subrectis sursum plus minus recurvis; pagine supra nitida atroviridi, subtus pallidissima; petiolulis incrassatis 7 mm. longis squamulatis; textura membranacea. Sori lineares, 1 cm. longi, 1 mm. lati utroque latere costae 1-seriatim inter costam et marginem



dispositi a se 2.5 mm. distantes, primum squamulis filiformibus indusii obtecti demum nudi.

**HABITAT.**—Inter Chapa et Mueng-Xen (Tonkin), in silva ad 4000 ped. alt., leg. *B. Hayata*, July 1917.

Very distinct from the other members of the genus by the much thinner subentire pinnae.

**Archangiopteris tamdaoensis** Hayata, sp. nov. (fig. 2).—Rhizoma horizontaliter vel plus minus oblique repens dorsiventrale in specimine exsiccato nostro, 9 cm. longum cum reliquiis stipitum 3 cm. crassum e latere ventrali radices incrassatas teretes emittens, reliquiis stipitum et stipulis persistentibus dense obtectum. Stipes 40–45 cm. longus basi dense sursum paucè squamulatus, squamulis lanceolatis apice acuminatis vel ad acumen filiforme abeuntibus, 3–5 mm. longis, locis duobus ad basin et ad 0.3 altitudinem a basi incrassatus; parte incrassata basilari geniculiformi, 1–2 cm. longa, 1 cm. lata utroque latere stipula persistenti instructa, stipulis coriaceis latere adaxiali stipitis a commissura 2-fida connexis 2-lobatis, lobis anterioribus minoribus rotundatis 7 mm.

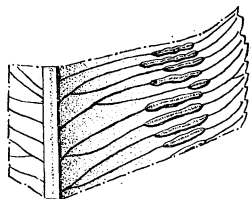


FIG. 2.—*Archangiopteris tamdaoensis* Hayata.

latis totiusque longis margine erosis interiore recurvis, lobis posterioribus majoribus semi-oblongis, 2 cm. longis, 7 mm. latis margine erosis membranaceis; parte incrassata superiore stipitis geniculiformi, 2 cm. longa, 1 cm. lata; stipites post finitas functiones ex apice partis basilaris incrassatae et iterum e parte incrassata superiore texturae degenerationi soluti. Frons simpliciter pinnata in ambitu obovata pari- vel impari-pinnata, pinnis 3–4, superioribus majoribus lanceolatis, 23 cm. longis, 5.5 cm. latis apice gradatim acuminatis rarius subito acuminatis (acumine lineari 2.5 cm. longo, 2 mm. lato margine subintegro rarius serrulato), basi triangulari-acutis vel cuneatis margine praeter basin acumenque minute serrulatis (serrula triangulari-subacuta); costa utraque elevata, venis lateralibus numerosissimis parallelis patentibus a costa angulo 70° egressis subrectis simplicibus vel e basi furcatis, venulis ad apicem serrulatum attagentibus, a se 1.5 mm. distantibus; pagina supra atroviridi subnitida subtus pallidissima, supra glabra

subtus paucissime squamulata vel glabra; petiolulis 5 mm. longis incrassatis. Sorus linearis utroque latere costae 1-seriatim secus venas vel venulas dispositus, 7-8 mm. longus, 1 mm. latus e costa circ. 1 cm. e margine circ. 4 mm. distans, primum squamulis filiformibus indusii obtectus demum nudus.

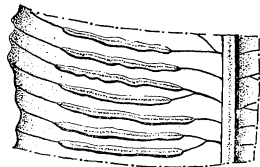


FIG. 3.—*Archangiopteris Somai* Hayata.

HABITAT.—Mt. Tamdao (Tonkin), in silva ad 3000 ped. alt., leg. *B. Hayata*, August 1917.

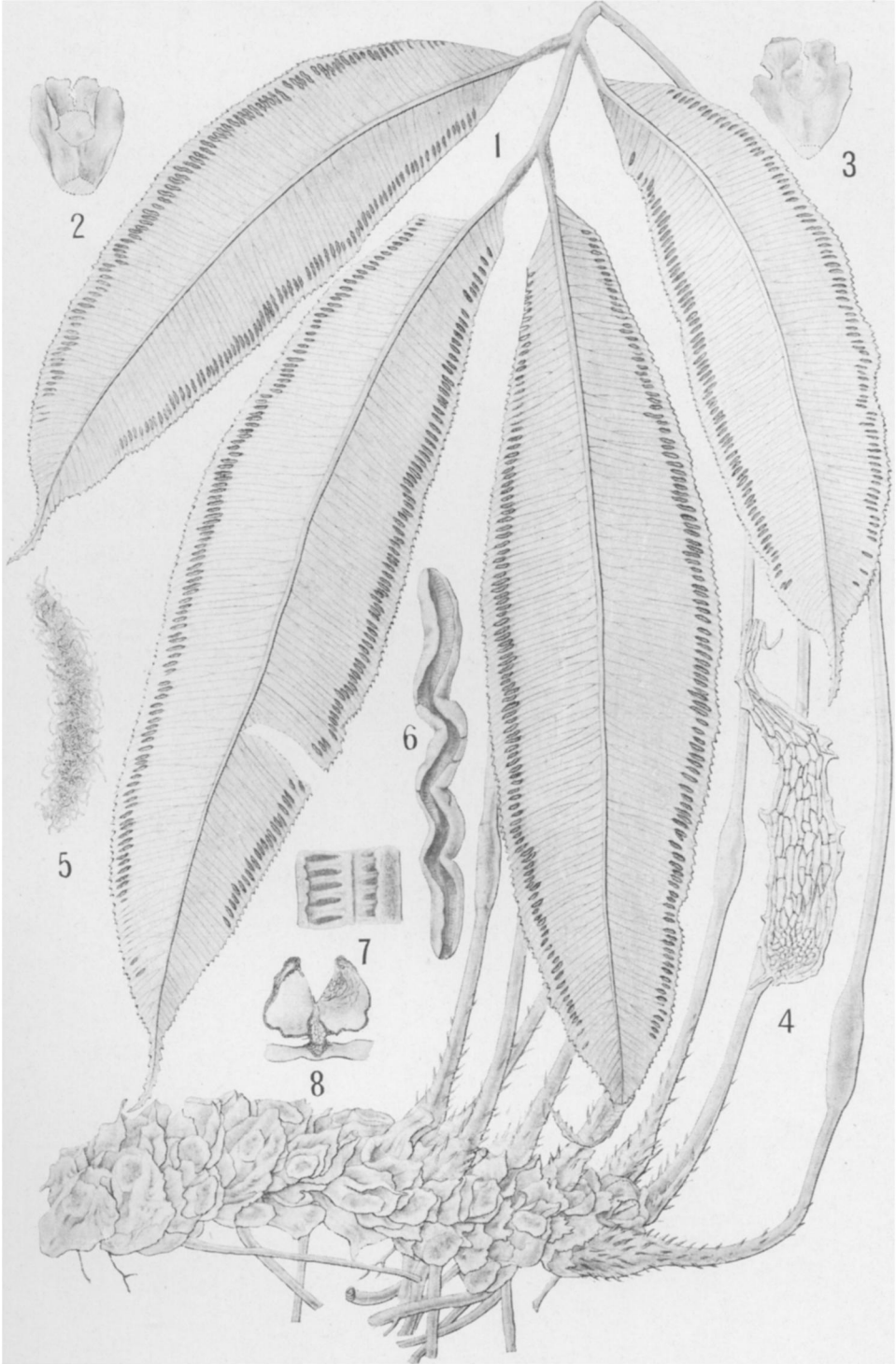
Allied to *A. Somai* Hay., but distinguishable from it in the shorter sorus located much nearer to the margin than to the costa, and in the less patent veins.

ARCHANGIOPTERIS SOMAI Hayata, Ic. Pl. Formosa 5:256; 6:154. *pl. 19* (fig. 3).

HABITAT.—Urai (Formosa).

#### EXPLANATION OF PLATE I

*Protomarattia tonkinensis* Hayata: 1, plant; 2, basal portion of stipe with stipules and a commissura, seen from abaxial side; 3, same portion seen from adaxial side; 4, scale on stipe; 5, young synangium; 6, full grown synangium; 7, portion of same synangium showing chambers; 8, section of same.



HAYATA on PROTOMARATTIA